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THE EFFECTS OF A TOKEN REINFORCEMENT PROCEDURE ON BUS RIDERSHIP[1]

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Tokens, exchangeable for a variety of back-up reinforcers, were delivered for several days to all persons boarding a clearly marked campus bus. This procedure increased ridership to 150% of baseline. The experiment was carried out to demonstrate the applicability of operant techniques to urban transportation problems. In this study, a token reinforcement procedure was introduced in an attempt to increase bus ridership while holding the costs of reinforcers to a minimum and circumventing the problems of individual satiety and preferences and of delivering cumbersome reinforcers. A methodology for establishing a token-exchange procedure in an "open-field" behavior setting, where the subject population size, geographic location, preferences, age, sex, preferred hours of mobility, *etc.* are unspecified, is also presented.

The tenets of operant psychology have recently been expanded beyond clinical and educational settings, although the leading proponents of this behavioral theory have been advocates of such an undertaking (*e.g.,* Skinner, 1953) for many years. Examples of broader application are illustrated by the work of Burgess, Clark, and Hendee (1971), who modified the littering behavior of individuals in a public theater and of Clark, Burgess, and Hendee (1972), who increased anti-litter responses in a public campground.

Apparently, no operant research has been designed specifically to contribute applicable behavioral knowledge to urban transportation problems. From the behaviorist's perspective, it is easy to speculate that transportation problems will not be solved solely on the basis of physical technology (*e.g.,* a new subway system). Physical technical advances must be accompanied by behavioral technology to deal effectively with issues that are, to a large degree, clearly behavioral (*e.g.,* few individuals riding buses, too many individuals driving private automobiles). One might assume that use of mass transportation facilities, such as a bus system, is low in this country because it is met with aversive consequences (*e.g.,* paying cash out of one's pocket, a reduction in schedule and route options relative to private car use, and/or the derogatory connotations of being a "bus rider") and that ridership would increase if any of these consequences were eliminated and/or potentially reinforcing events were scheduled to follow bus-riding responses.

The present study sought to manipulate systematically the consequences for boarding a bus in an attempt to increase ridership. In a preliminary study leading to the present experiment, bus ridership on a university campus bus was increased to 213% of the baseline when every rider received a quarter (25¢) and the verbal comment "thank you for riding the bus" as he boarded the vehicle. The present study was designed to extend these findings by demonstrating the applicability of the operant ap-

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proach to transportation problems using a more practical procedure than paying passengers cash. While still dealing with an atypical subject population (*i.e.,* university students), a token reinforcement procedure was introduced in an attempt to: (1) increase ridership, (2) hold the costs of the reinforcement procedure to a minimum, (3) avoid problems of satiety and individual reinforcer preferences, and (4) circumvent the problems of delivering cumbersome reinforcers.

An allied goal was to develop a workable methodology for establishing a token exchange procedure in an "open-field" behavior setting. In most token economies (*e.g.,* Kazdin and Bootzin, 1972), a subject population that is well defined in terms of size, members, geographic location, *etc.* exchanges their tokens for back-up reinforcers at a small room, usually called the "store", during specific hours of the day. However, in the present experiment, a token exchange procedure had to be established, with minimal expense and labor, that could accommodate a large number of unspecified subjects from an open-ended population (*i.e.,* anyone who happened to board the experimental bus and receive a token), located at various geographic locations within a town during diverse hours of the day.

METHOD

Subjects and Setting

The experiment took place, during winter term, on the campus of a large state university situated in a "college town" of 18,389 inhabitants (excluding students). The university population consisted of 29,144 students and 6989 faculty and staff employees. The student population consisted of 23,919 undergraduates (8646 females and 15,273 males) and 5225 graduate students (1383 females and 3842 males). The total number of individuals in this setting were considered "experimental subjects".

The bus route used in the experiment spanned 2.5 miles of the university campus, passing classroom areas, university business areas, undergraduate dormitories, and housing for graduate students and their families. Bus stops and signs were placed at approximately 0.2-mile intervals along the entire route.

Apparatus

Two 1960 General Motors 35-passenger diesel buses were used. Each had a front door for boarding passengers and a rear door for exiting passengers. A turnstile, located at the front of each bus, mechanically counted all the passengers passing through it. Three fluorescent red stars, 30 in. in diameter, were attached to the front and both sides of one of the buses during all reinforcement sessions.

A sample token is shown in Figure 1. These tokens were "wallet size" cards printed on bright red paper. The back-up reinforcers consisted of free bus rides, cheeseburgers, ice cream cones, records, cigarettes, beers, pizza, movies, coffee, tea, recipient's name in the newspaper for being an "eco-hero" (favoring ecological causes), candy, potato chips, and play tickets.

Questionnaires, used periodically throughout the experiment, were designed to assess the origin, destination, length, and purpose of each trip. In addition to this information, questions were asked that attempted to characterize the various types of individuals using the bus (*e.g.,* student, faculty, *etc.*) and what modes of transportation they exchanged for bus riding.

Instructions as to the experimental contingencies were presented in the form of a 5-in. by

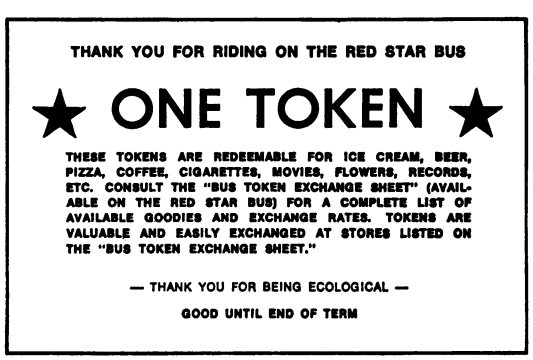

Fig. 1. A sample token.

5.5-in. advertisement in the university newspaper. These papers were widely distributed to all campus buildings and residences and many downtown businesses before 7:00 a.m. every weekday morning. The advertisement consisted of a map of the campus bus route used in the experiment, and it explicitly delineated that all individuals boarding the "Red Star Bus" during a certain number of days would receive a token that could be redeemed for various items and services.

A mimeographed sheet of paper ("Token Exchange Sheet"), which explained the experimental contingencies and listed the full range of back-up reinforcers, the cost of each in tokens, and where they could be obtained, was available for handout on the "Red Star Bus".

Procedure

Each of the two buses traversed the campus route 42 times each weekday, from 7:30 a.m. to 6:00 p.m. One of the buses (always the same one with the same driver) left the west end of the route every half hour on the hour and half past the hour, and then left the east end of the route every half hour at 15 min and 45 min past the hour. Alternatively, the other bus left the west end of the route every half hour at 15 min and 45 min past the hour, and left the east end of the route every half hour on the hour and half past the hour. Thus, the two buses traversed the same route in opposite directions, and any stop on the route was serviced by both an eastbound and westbound bus every 15 min.

Throughout the experiment, route, drivers, and schedules were unchanged. Similarly, every passenger was required to pay the usual 10¢ fare to the driver.

The data of primary concern were the total daily ridership counts (Mondays through Fridays) for each bus as recorded by the turnstiles and verified by the cash receipts.

All conditions of the experiment were held constant until several days of stable ridership counts for each bus were observed (Baseline I). The advertisement was then placed in the school newspaper announcing that passengers boarding the "Red Star Bus" (Experimental Bus) that left the west end of the route on the hour and half past the hour would receive tokens (Token Condition). For the next several days, the red stars were placed on this bus and each passenger received a token immediately upon boarding. He was also handed the Token Exchange Sheet. The passengers boarding the other bus, on the same route, received no tokens (Control Bus). The newspaper advertisement was presented daily during the Token Condition. These conditions were held constant until a clear trend in daily ridership count for the Experimental Bus was observed. At this point, the token handout was terminated and conditions returned to those of Baseline I (Baseline II). Baseline II conditions were held constant for several days.

Tokens were handed to the passengers by the experimenter who stood directly behind the bus driver. Three experimenters divided this task into equal time segments of the daily 7:30 a.m. to 6:00 p.m. bus-operation period. The experimenters were instructed to answer questions about the method of token exchange, *etc.,* but inquiries as to the reason for the giveaway were answered with a mimeographed "explanation sheet" which, in general terms, stated that the project was funded research, designed to develop methods to increase mass transit patronage.

Several town businesses were contracted to function as token exchange centers. Each merchant was told that tokens would be given out for a certain time period on a particular bus, and if he allowed these tokens to be traded at his establishment, the experimenters would reimburse him for each token he collected. Upon agreement to this plan, a contract was written. This specified the exact reimbursement value (which varied from 5¢ to 10¢ per token), what items the merchant was to exchange for the tokens, the number of tokens required for each exchange item, and when to stop accepting tokens (a specific date was given, which was one month after the tokens were last given out on

the bus). Each participating business establishment was contracted to accept tokens for only one item from the list of back-up reinforcers. This procedure allowed determination of how tokens were spent (*e.g.*, all tokens received at business "X" were traded for beers only).

A card was attached to every cash register of each participating merchant. Each card bore a sample token, instructions as to which item tokens could be exchanged for, the price of the item in tokens, and a reminder that the tokens were valuable and should be kept in the cash register for future reimbursement.

Periodically, an agent of the experimenters (unknown to the merchants) spent a few tokens at various contracted merchants to verify the smooth operation of the token exchange system. On a weekly basis, another agent of the experimenters (known to the merchants) collected from and paid each merchant for the tokens accumulated.

The questionnaire described above was given out on the Experimental Bus on a Friday of Baseline I, a Friday of the Token Condition, and a Friday of Baseline II. In each case, distribution was from 8:30 a.m. to 9:30 a.m., from 12:30 p.m. to 1:30 p.m., and from 5:00 p.m. to 6:00 p.m. All individuals riding the Experimental Bus during these times were sampled. The questionnaires were collected as the riders got off the bus.

Weather data were collected daily for the duration of the experiment. Variables recorded included daily means of temperature, solid precipitation (snow), and liquid precipitation (rain).

RESULTS

Figure 2 illustrates the daily ridership counts for the Experimental and Control Buses during the various conditions of the experiment. During the 16 days of Baseline I, the Experimental

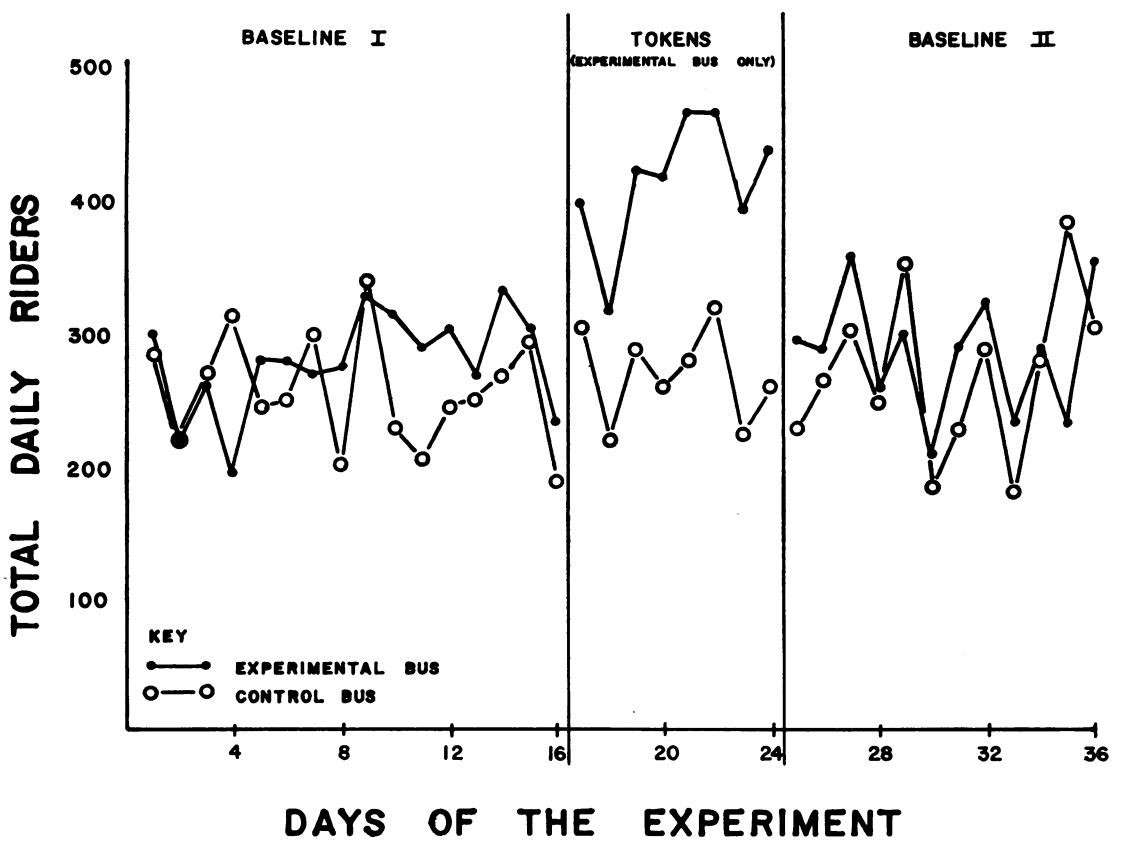

Fig. 2. Daily ridership for the Experimental Bus and the Control Bus for the entire experiment.

Bus had a mean daily ridership of 280 riders and the Control Bus had a mean daily ridership of 255 riders. Introduction of the Token Condition immediately increased the ridership on the Experimental Bus to a mean of 420 daily riders for the eight days of this condition (150% of Baseline), while the Control Bus ridership increased to a mean of 270 daily riders during this period.

Baseline II was initiated and held constant for 12 days. Figure 2 illustrates that the ridership on the Experimental Bus returned to that of Baseline I (mean daily ridership, 285). The ridership for the Control Bus during Baseline II remained at a mean of 270 daily riders (the same as the ridership for this bus during the Token Condition). The ridership changes on the Experimental Bus did not systematically change with weather variables.

Table 1 lists the back-up reinforcers, their cost in tokens, the number of each back-up reinforcer sold, and the total number of tokens exchanged for each back-up reinforcer. Of the 3340 tokens distributed during the experiment, 2736 (83% of the total distributed) were returned. Tokens were most often exchanged for bus rides; no tokens were exchanged for play tickets. No instances of breakdown of the token exchange system were reported.

Figures 3 and 4 present summary results from the questionnaires that were given out on the Experimental Bus during the various conditions of the experiment. The time periods (see above) for distributing the questionnaires allowed a sampling of 34% to 41% of the total riders on the bus during the entire sample day. Figure 3 depicts the length of bus trips made during the different conditions of the experiment. It is clear that trip lengths were not modified by the Token Condition. This conclusion was supported by observations of the three experimenters riding this bus that only five to 10 individuals, during the eight days of Token Condition, immediately disembarked upon receiving a token.

The change in passenger "profile" during the various conditions of the experiment is depicted in Figure 4. The Token Condition attracted primarily walkers, undergraduates, and individuals making academic trips.

Table 1

Accounting of the Tokens for the Entire Experiment

Back-Up Reinforcer	*Token Cost*	*Number Sold*	*Total Tokens Spent*		*% of Tokens Distributed*
Bus Ride	1	1757	1757		53%
Cheeseburger	3	73	219		7
Ice Cream Cone	2	106	212		6
Record Album	28	5	140		4
Pizza (slice)	2	42	84		3
Coffee or Tea	1	78	78		2
Campus Movie	4	19	76		2
Pack of Cigarettes	5	12	60		2
Draft Beer	2	25	50		2
Candy or Potato Chips	1	37	37		1
Name in Newspaper	1	23	23		1
Play Ticket	10	0	0		0
	Total Tokens Spent		= 2736	=	83%
	Tokens Not Spent		= 604	=	18%
	Total Tokens Distributed		= 3440	=	101%*

*This error is due to rounding of percentages.

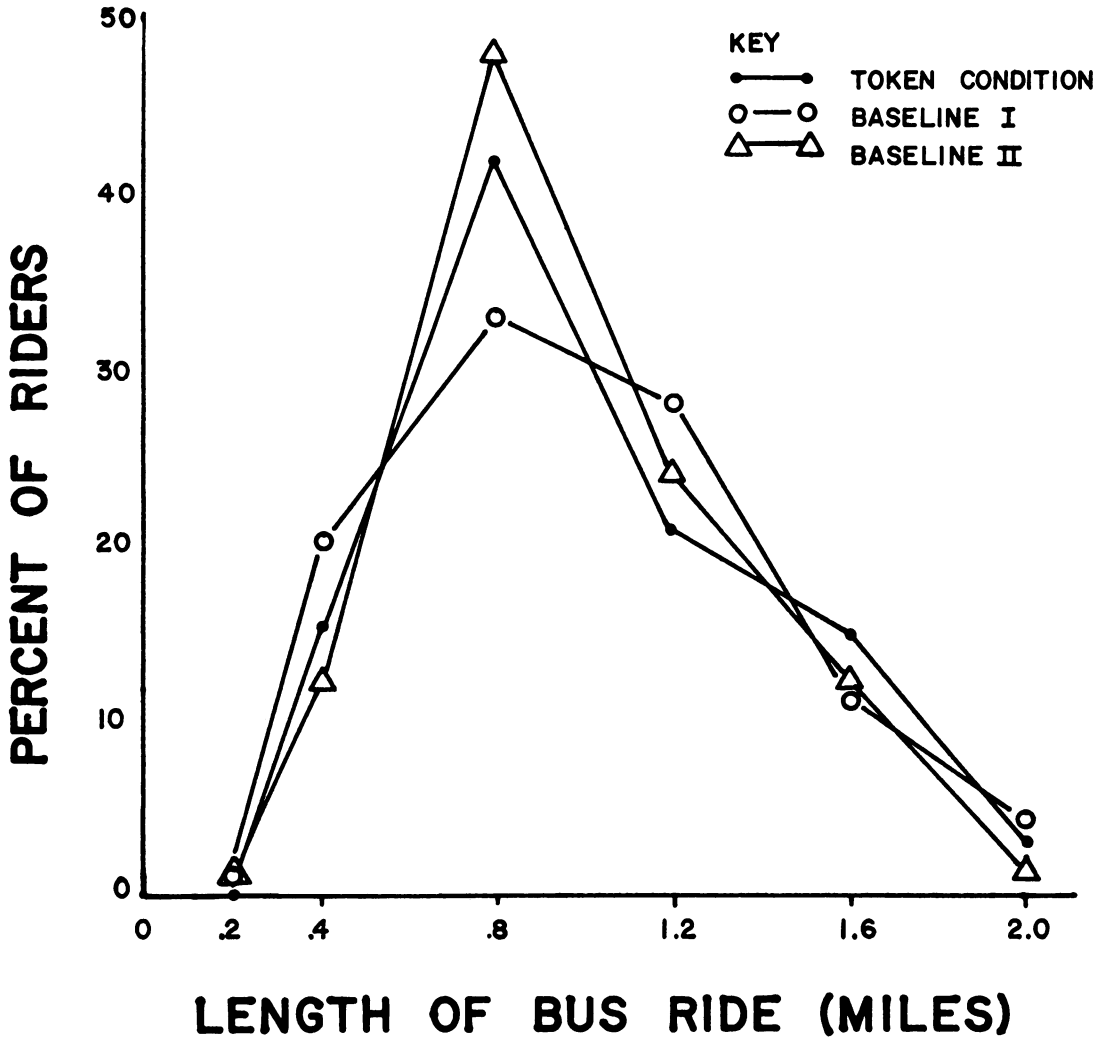

Fig. 3. The proportion of total riders, sampled during the different conditions of the experiment, that took various-length bus rides.

DISCUSSION

The eight days of increased ridership on the Experimental Bus during the Token Condition constitute solid evidence of the successful application of a token reinforcement procedure to a transportation setting. The magnitude of this ridership increase, and the ability to maintain it for several days, suggest that the problems of individual preferences and satiety were avoided. Certainly, one would want to monitor the long-term riding behavior of individuals to verify these indications.

The stable ridership on the Control Bus, during all conditions of the experiment, indicates that the increased ridership on the Experimental Bus during the Token Condition was not caused by riders simply shifting from one bus to the other. The Token Condition attracted new riders to the system.

The goal of reducing the costs of the reinforcement procedure was also accomplished. Two reasons account for this: (1) several merchants allowed the tokens to be bought back by the experimenters at a discounted rate, and (2) 18% of the tokens were not traded for back-up reinforcers. The cost of buying back all tokens given out during the experiment totalled $128.

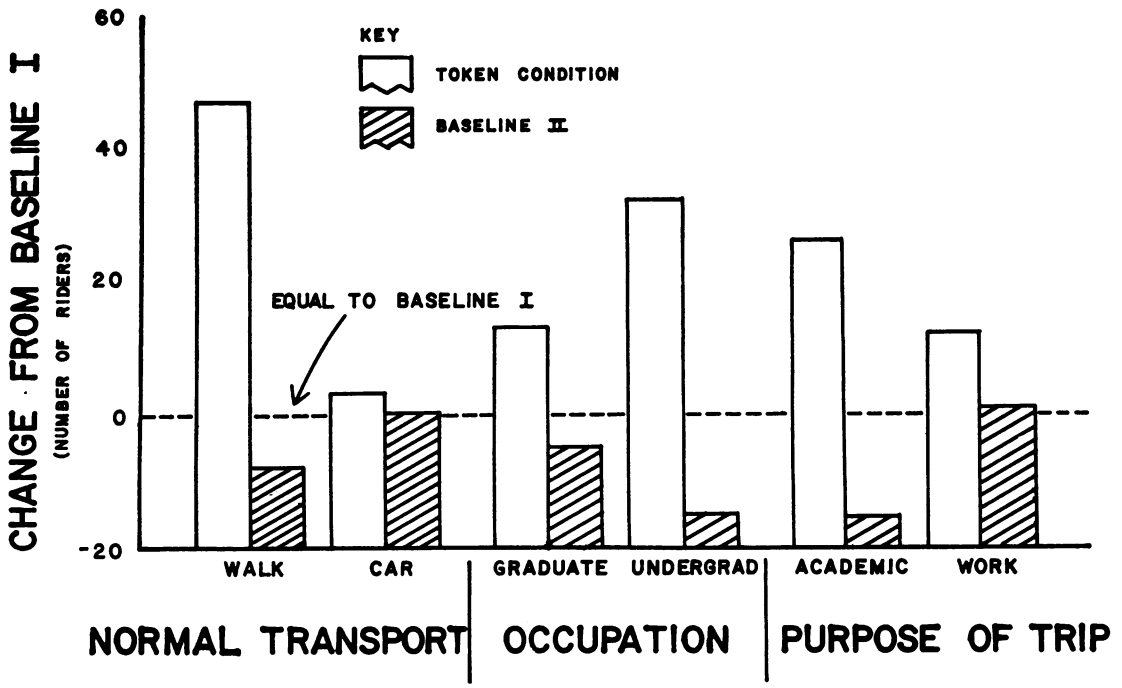

Fig. 4. The change in ridership characteristics during the different conditions of the experiment. This change is plotted as the simple numerical difference between the number of individuals answering a question on Baseline I and the Token Condition, or Baseline I and Baseline II (*e.g.*, during the Token Condition, 47 more riders than during Baseline I said they were normally walkers).

This compares to a projected cost of $728 if quarters (25¢ pieces) had been given out instead of tokens for the same eight-day period with a similar ridership increase.

The distribution of tokens proved to be an easy task, relative to the possible complications of delivering potential reinforcers such as coffee, coffee with cream, donuts, and so forth on a constantly starting and stopping bus. Although tokens were delivered by an experimenter, a mechanical dispensing device, attached to the turnstile, could easily replace the researcher's labor.

The establishment of local businesses as token exchange centers was a complete success, as evidenced by several factors. Primarily, 83% of the tokens were exchanged. Also, there were no subject, merchant, or experimenter agent reports of problems with the token exchange system. Of great importance, all merchants were quite happy with the mechanism of exchange and reimbursement and expressed their willingness to participate in future programs of this nature.

Subjects valued the tokens from the start of Token Condition. This was evidenced by the observation that no subjects discarded them, most put the tokens immediately in their wallets, and a "black market" exchange was frequently observed (*i.e.*, the experimenters noted subjects bargaining for the tokens in the rear of the bus). The "instant" value of the tokens may have been enhanced by the fact that their redemption value at known, trusted business establishments was clearly stated on the token.

By establishing the merchants as the token exchange centers, many of the problems of operating a token economy in an open-field behavior setting were reduced. Subjects at diverse geographic locations in the town could exchange their tokens at various times of the day. The merchants implicitly (because it was their business) stocked large supplies of back-up reinforcers, sparing the experimenters this cum-

bersome, expensive procedure. The merchants' large stocks also allowed an index of back-up reinforcer preference to be unbiased because no back-up reinforcers were exhausted. However, the data presented in Table 1 should be interpreted with caution as indicating back-up reinforcer preferences. Some items may have not been purchased because they required more tokens, or other items may have not been purchased because the exchange merchant was less accessible (*e.g.,* far in miles from the majority of token possessors).

The labor and dollar costs were greatly reduced by establishing the merchants as the token exchange centers. The only labor requirement for the experimenter was initially to seek contracts with merchants and then periodically collect and reimburse the merchants for tokens collected. As mentioned, cost was reduced because many merchants allowed the experimenters to re-purchase the tokens at a discounted rate because of the obvious advertising benefit of being involved in the experiment.

As applications of the principles of operant psychology are increasingly expanded to open-field behavior settings, it would be appropriate and expedient to insert these programs into existing social institutions, such as a town business center. Such an approach would substantially ease the task of applying operant techniques to broader settings. It is possible that the burden of operating and maintaining a reinforcement program in an open-field behavior setting could be further shifted from the psychologist to an existing institution. For example, a continuation of the present work will be directed toward shifting the total cost of the reinforcement procedure to merchants. Hopefully, merchants will give percentage discounts on their store items for tokens. In exchange for reduced profit on those items, the merchants should realize increased business (as will the bus company) as a result of bargain-seeking consumers.

Although the effects of the instructions in the form of newspaper advertisements were not determined in this study, it is reasonable to assume from previous reports (Ayllon and Azrin, 1964) that they shortened the time span of the ridership change during the Token Condition. In a preliminary study, bus ridership was found to increase more quickly when reinforcement was paired with instructions.

The questionnaire yielded important data by empirically verifying ridership characteristics and by countering a pre-experimental hunch that mean trip length would be shortened during reinforcement sessions. Accessory data are quite important for monitoring the impact of operant manipulations and often point to directions for future research. Studer (*unpublished*) suggests the use of such an ecological perspective (*i.e.,* monitoring many indices of experimental effects) when applying operant principles to large populations.

One major difference between the present experiment and most operant experiments must be noted. Typically, operant research deals with behavioral change in a single subject. This change is indexed by the rate of a predefined response emitted by that individual. However, the present study did not record bus-boarding response rate for individuals. Instead, the total population of the university setting was treated as a single organism and each individual boarding the bus was treated as a response. At present, this seems to be an appropriate extrapolation and a valid methodological perspective to take; however, this issue certainly merits further resolution.

Clearly, the present experiment represents the early stages of development for the application of operant techniques to the problem of low bus ridership. Research must eventually deal with a subject population other than university students and walkers. If the operant approach is to make a truly viable contribution to resolving transportation problems, it must effectively modify the transportation behaviors of individuals who are car drivers and "average" citizens. Similarly, maintenance procedures and more economical mechanisms of reinforcement

must be developed. Economic viability is the emphasis of research now underway. It is hoped that the scheduling of tokens and/or the back-up reinforcers will increase and maintain high ridership levels equivalent to, or greater than, those realized under a continuous schedule of reinforcement. Such a finding might enable a bus company to operate a self-supporting reinforcement procedure. The company would gain revenues as a result of the increased ridership, while reinforcing only every n^{th} rider.

Simultaneously, another avenue of research is aimed at determining the economic viability of the reinforcement procedure. This research is attempting to determine the savings to an urban center (*e.g.*, dollar savings due to reduced road building and maintenance, traffic personnel, *etc.*) that would result from increased patronage of mass transit. There is no reason to analyze the economics of a bus system in isolation from other systems. Money saved by reducing automobile traffic could be transferred to a reinforcement procedure aimed at increasing ecologically oriented transportation behaviors.

REFERENCES

Ayllon, T. and Azrin, N. H. Reinforcement and instructions with mental patients. *Journal of the Experimental Analysis of Behavior,* 1964, **7**, 327-331.

Burgess, R. L., Clark, R. N., and Hendee, J. C. An experimental analysis of anti-litter procedures. *Journal of Applied Behavior Analysis,* 1971, **4**, 71-75.

Clark, R. N., Burgess, R. L., and Hendee, J. C. The development of anti-litter behavior in a forest campground. *Journal of Applied Behavior Analysis,* 1972, **5**, 1-5.

Kazdin, A. E. and Bootzin, R. R. The token economy: an evaluative review. *Journal of Applied Behavior Analysis,* 1972, **3**, 343-372.

Skinner, B. F. *Science and human behavior.* New York: Macmillan, 1953.

Studer, R. G. *Urban design, learning theory, and behavior modification.* Unpublished paper read at the meetings of the American Association for the Advancement of Science, Washington, D.C., December, 1972.

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